

# Cloud based Mobile Diabetes and Health Management System

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**ABSTRACT:** The paper presents a technique to resolve the need for diabetic patients to get their health being monitored 24X7 and updated about their health conditions by their doctors. This technique mainly focuses on diabetic patients. It consists of an intelligent device which monitors the readings and sends them to the patient's phone through Bluetooth technology. Our paper consists of 2 main components. The first one is the intelligent device and patient/doctor unit. The latter is the cloud based module unit. The interaction between the doctor and the patient gets stored in the cloud where it is supported with the educational module, the decision making module and the server which controls these systems. The transfer from the reading meter unit is done through an intelligent device through multiplexing concepts. Then, this data is sent to the doctor unit through network. The most common disease in India is Diabetes, and then comes other health barriers caused due to irregular cholesterol levels and blood pressure levels. This paper also consists of the solution to provide the patients with the education system they need to acquire about their health. The health care cloud system provides all the stored profiles of the patients. The patient also gets notified about his health on a timely basis. India's prime concern lies with the diabetic patients and their prevention to such chronic diseases at the earliest.

Key words—mobile diabetes management; blood pressure; cardio check; database storage.

## INTRODUCTION

Human health is of prime concern, especially when it comes to diabetes, which is more common in our country. It makes people's life very pathetic. Diabetes is fast gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with disease. In 2000, India (31.7 million) topped the world with the highest number of people with diabetes mellitus followed by China (20.8 million) and the United States (17.7 , around seventeen million) in second and third positions respectively. According to a survey by Wild et al, the prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030 with the maximum increase in India. It is predicted that by 2030, diabetes mellitus may afflict up to 79.4

million individuals in India, while China (42.3 million) and United States(30.3 million) will also see significant increase in those affected by the disease. India currently faces an uncertain future in relation to the potential burden that diabetes may impose upon the country. Many influences affect the country, and identification of those factors is necessary to facilitate change when facing health challenges. The aetiology of diabetes in India is multifunctional and includes genetic factors coupled with environmental influences such as obesity associated with rising living standards, steady urban migration, and lifestyle changes. This paper mainly concentrates on Type 2 diabetes which is more common in India. Cholesterol is another major concern for the people in India. The Normal level of cholesterol is 200 mg/dl. LDL cholesterol (Low Density Lipoprotein) cholesterol should be < 100 mg/dl (ideally should be not more than 70 mg/dl). HDL cholesterol should be > 45 mg/dl (ideally should be > 50 for women and > 45 for men). Triglyceride levels should be < 150 mg/dl ( ideally should not be more than 100 mg/dl). The third, according to a recent survey, the new normal Blood pressure level in India is 140/90. Blood pressure levels are of major concern for most of the diseases, mainly, Diabetes. It is monitored for accurate levels. The irregular pulse levels are also monitored along with the other 3 using Pulse-Oximeter concept. To monitor all these 24X7, we use an intelligent device designed with the help of Arduino and programmed accordingly. The daily readings ,as prescribed by the doctor , are taken and stored in the device, then transferred to the patient's mobile through Bluetooth as well as it gets stored in The Cloud storage through EDGE or 3G.The graphs, charts are provided based on the readings for future use.

## II.METHODOLOGY

### A. The System's Clinical Requirements and Design Analysis:

To design and develop the architecture of the health care system, the clinical requirements and design analysis of the Cloud smartphone system were based on extensive discussions with clinical

collaborators in the US and INDIA. From these discussions, the self-management of blood glucose (SMBG) and self management blood pressure and cholesterol levels was determined to be an important clinical approach suitable for an Indian diabetes management system. The following functionalities were mentioned:

- A specific schedule of readings for each diabetic patient set by the diabetic nurse rather than the patient.
- Reminding the diabetic patient to send the glucose test readings, blood pressure test readings and food intake reports on schedule.
- Providing a brief feedback on the patient's status when the patient inserts a reading.
- Establishing a sufficient connection between the medical staff and the diabetic patient using SMS or e-mail.
- Managing the hypoglycaemia via the system without the need for diabetic nurse intervention, based on the critical time of the hypoglycaemia event.
- Providing the specialist diabetic nurse the ability to send SMS feedback regarding blood glucose or blood pressure level readings.
- Providing the diabetic patient and specialist nurse with a data visualisation tool to display the data in tables and charts. All the above mechanisms are followed for blood pressure and cholesterol levels and graphs and readings are plotted accordingly and sent to the clinical unit through the network.
- Supporting the specialist nurse with a diabetic decision support system.
- Supporting the diabetic patient with an educational program.

## B. System Overview:

The intelligent mobile health management and educational system targeted for India is depicted in Fig. 1 below.

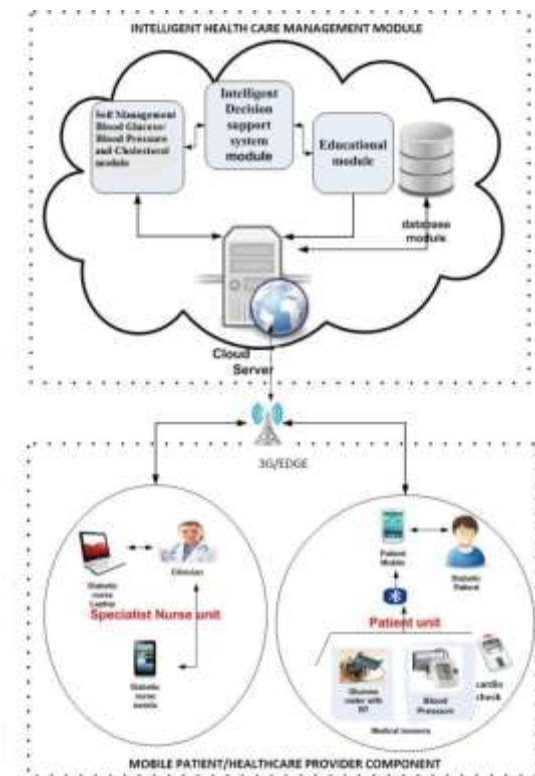


Fig.1.Cloud Smartphone system

The Cloud Smartphone system consists of two components:

### 1) The Mobile Patient/Healthcare Provider Component:

This component includes two units:

#### a) The Patient Unit:

This unit consists of a Bluetooth enabled (1) Smartphone, (2) blood glucose unit and (3) blood pressure device. With this unit the patient takes medical readings (e.g., 2 x blood glucose levels daily), as prescribed by the clinician. This data is then transferred via a 2G/3G/LTE network to the secured cloud server. The diabetic patient is provided with a friendly web interface that includes a data management environment that offers a personal medical profile and a record of glucose and blood pressure levels in the form of tables and charts.

#### b) Specialist Nurse Unit:

This unit includes a friendly web interface and mobile application. These two present a diabetes data management system that allows the specialist diabetic nurse to communicate with and monitor the diabetic patient remotely.

### 2) The Intelligent Health care Management Component:

This component consists of the following modules:

#### a) A Database Module:

This database stores the information related to the individual patient's data and records regarding laboratory examination results (e.g., HbA1c test results) as well as the specialist diabetic nurse's

comments on the readings. The database is designed based on the MySQL standard, enabling communication with the hospital information system, where the system will be deployed.

**b) An Intelligent Decision Support Module:**

The fuzzy decision support system (FDSS) includes advanced tools that provide intelligent processing of the diabetic patient's data using fuzzy logic concepts. The DSS is able to monitor health and make an evaluation of each patient, leading to recommendations and feedback on his or her current diabetes status and treatment.

The DSS provides each patient with a clear picture of his or her health status via an SMS for every glucose reading taken. Furthermore, DSS uses fuzzy logic concepts to support the specialist diabetic nurse in calculating the amount of insulin used.

**c) SMS Reminder Module:**

This module monitors the diabetic patient's schedule and sends automatic SMS reminders for scheduled readings, etc. When the diabetic patient is required to send glucose/blood pressure readings at a specific time, the reminder module will alert the patient with SMS at the time set in the system.

**d) Diabetes and other Health Educational Module:**

The diabetes education program is considered an essential part of SMBG for improving the diabetes patient's self-management. The key factor of the program is to develop and increase the patient's knowledge, confidence and skills, empower the patient with greater disease control and incorporate efficient self-management in his or her daily life [9]. The Diabetes Education and Self-management for Ongoing and Newly Diagnosed (DESMOND) programme is the most highly recommended diabetes education program in the US and India. It is a one- or two half-day course that empowers participants with knowledge and skills to help them gain control of their condition. In this work, the DESMOND module was incorporated into the system using the mobile patient unit. This allows the diabetic patient to access the DESMOND educational material securely, using a patient username and password.

**3)The Rechargeable Intelligent Device:**

The device consists of a memory component of RAM type with erasable memory type, a 7 segment LCD display unit for displaying the output. It consists of a 3.5 mm jack ports. There are 3 ports provided, each for Glucose meter input, Blood pressure input, Cholesterol input respectively. The fourth system is an outward port which is used to interface with the pulse oximeter that we note down by placing in our thumb. The modes are selected by means of a 4:1 multiplexer or a toggle switch based on selection lines. For which 2 selection lines are provided, in case of a 4:1 multiplexer. The

Selection lines are thereby referred with 4 cases here (00;01;10;11) for which 00 – Glucose meter input ; 01 – Blood pressure level input ; 10 – Cholesterol Input ; 11 – Pulse Oximeter input are selected accordingly as per the modes. Then the selected mode data is being exchanged from the device to the smartphone through Bluetooth. There is a reset button for the purpose of new readings. The device can also be programmed with the help of an ARDUINO NANO module by interfacing it with a Bluetooth module and coding it according to our requirements.

**4) System Implementation:**

A prototype architecture system was developed in the Medical Information and Network Technologies (MINT) Research Excellence Centre at Kingston University, London, using PHP and MySQL for a web application environment, objective C for the iPhone and Java for the Android® mobile applications. Researchers discovered that the system was able to carry out all the functional requirements mentioned in the system requirements section above and demonstrated that medical data from a remote patient could be transmitted and the information dynamically changed. Fully automatic data transfer was achieved for the blood glucose sensor using Bluetooth (Polymap Wireless adaptor or by means of multiplexer mode select through 3.5 mm jacks) as shown in Fig. 2.

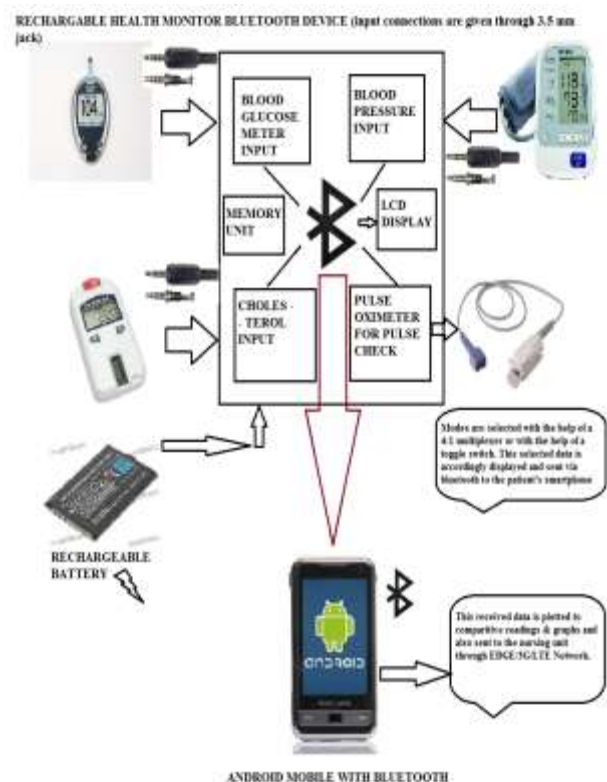


Fig.2 Rechargeable Health Monitor Bluetooth Device

An example of the individual daily blood glucose readings logbook and a chart of the mobile application are shown in Fig.3. As presented in Fig. 3, the Smartphone mobile application allows the patient to display glucose readings in a logbook or chart. Furthermore, the chart is divided into three zones based on the blood glucose readings, which provides the patient with a general sense about his or her diabetes status. The above said system is an effective method to create a log of the patient's health and keeps tracking his previous and present graphs for future outcomes. It also provides us with recommendations and various other health based feedbacks from the cloud server to the patient.

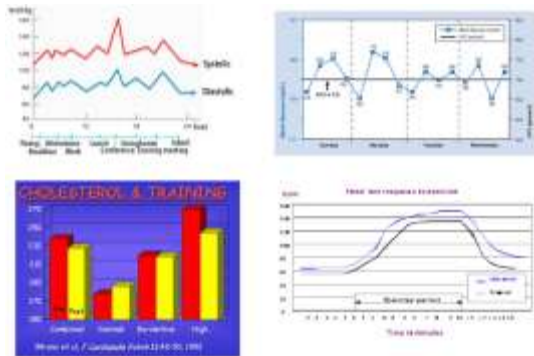


Fig.3. Graphical periodic representation of logs created

### III. CONCLUSION AND FUTURE WORK

This system, based on state-of-the-art technological infrastructures, is presented to achieve intensive monitoring of daily blood glucose levels, blood pressure levels, cholesterol levels with special optimized treatment and a normal lifestyle for the type 2 diabetic patient in India without restrictions on daily life. The integrated decision support system provides the specialist unit nurse with important individual diabetes management facts that are essential for decision making. The integrated educational system provides the diabetic patient with the most important information about diabetes and regular health management based on the study and other forms. Future research aims to evaluate the system by reducing the size to more compact model. The future work also aims at

making the size as compact as a wearable equipment which can be very handy to the users and easier to use. The wearable device aims at having an easier access for the patients to communicate with the clinical nurse unit. The device will be designed to be a better mobile unit wherever the patients go (on the move).

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